angles GZH, HPK, have equal angles, GZH and HPK, because GZ is parallel to HP and ZH to KW, and the sides ZH, ZG, KP, PH which are about the equal angles proportional, therefore the remaining angles HGZ, GHZ of the triangle GZH are equal to the remaining angles PHK, PKH of the triangle HPK, each to each which are opposite to the homologous sides, so the angle HGZ is equal to the angle PHK and the angle GHZ is equal to the angle PKH. The angle ZHP is equal to the angle HPK, because ZH is parallel to PK and PH falls upon them; and the three angles GHZ, ZHP, and PHK taken together are equal to the three angles HKP, HPK, and PHK taken together, that is to two right angles. So to the point H in the right line ZH are drawn two right lines KH and GH on opposite sides, making the two angles KHZ and GHZ taken together equal to two right angles; therefore the two right lines form one straight line; But BC is bisected in K by construction, and the right line GHK drawn through G and H bisects BC. Therefore in the triangle ABC, CD and BE being drawn, cutting each other in F, and the sides of the triangle in D and E, and the diagonals AF DE of the trapezium ADFE being drawn and bisected in G and H, the right line GH joining the points of bisection being produced bisect the base. Q. E. D.

No. XXXIV.

An Account and description of a TEMPORARY RUDDER, *invented by Captain William Mugford, of Salem, (Massachusetts) and for which the Society awarded to him a Gold Medal, from the Extra-Magellanic fund.*

Motto. Nil desperandum—cras iterabimus æquor.

Read November 16th 1804.

THE Ship Ulysses of Salem (Massachusetts) under the command of Captain William Mugford, sailed from that port on the 2d day of January 1804, bound to Marseilles. On the

5th of that month being in Latitude 41 Longitude 65 from the meridian of London, she experienced a heavy gale of wind, and while running 8 and 9 knots, a large sea struck her stern and carried away the rudder at the waters edge, when the vessel immediately broached to. The main-mast was sprung and the hull lay exposed to every sea. In this unfortunate situation, Capt. Mugford was reduced to the necessity of steering the ship with cables over the quarters for upwards of twenty days, making however the best of his way towards the western Islands and Madeira. The weather during all this time was extremely boisterous, and the ship much exposed to the Sea. It was during this interval that Capt. Mugford planned and executed his temporary rudder. This rudder is made of a spare top-mast and other spars well lashed and secured together, and fastened to a false stern-post by eye-bolts serving as braces, and crowbars and other substitutes for pintles. The false post is also firmly secured to the old stern-post by the guys and old rudder braces which are tennoned into it, tiller ropes are fixed to each end of an old iron tiller; or for want of it, an iron anchor-stock, or a piece of scantling, or a spar is fixed across the rudder and supported with rope-braces, so that the vessel is steered in the usual manner with the wheel:—and in order to keep this rudder steady in its place, while fixing it, a cannon or some other sufficient weight is fastened to the bottom of it.

Capt. Mugford (after observing that great difficulty would be avoided in the construction, if the master of every vessel, was in possession of the measure of the rudder and the precise distance of the gudgeons,) informs us that he found it to answer every purpose which could be expected from a temporary rudder, that his vessel was found to steer by it with the greatest ease, and that he sailed with it during fifty days, at the end of which time he arrived in safety at the port of his destination.

The drawing of the rudder, the following description of it, and the remarks subjoined, were furnished to the society by Capt. William Jones, one of their associates, from the model of the rudder sent by the Inventor and deposited in the cabinet of the Society.

MUGFORD'S TEMPORARY RUDDER.

A, (Plate V. Fig. 7.) Is the main stern-post from which the original rudder has been torn.

B, Is the *false stern-post* made of a spare top-mast sided so as to fit the main stern-post, with mortices to receive the braces h h h, or the fragments thereof which remain upon the post.

C, Is the temporary rudder made of the (residue of the) top-mast and the sprit sail yard, studding sail booms, or any spars that can be spared with the least inconvenience—They are cut to the proper length and partially sided and firmly bolted or *treenailed* together. The sides are then flatted a little with the adze and boards nailed across and wooldings of rope bind the whole together as represented in the figure.

D D D D, Represent the spars of which the rudder is constructed.

E, Is a small spar or piece of plank fitted on each side of the false post to lead the guys clear and prevent their chafing; they are also bolted through from side to side and rivetted to secure the false post from splitting, or if bolts are not to be had lashings are substituted as represented in the figure.

F F, Are stout flat cleats well nailed or bolted on each side of the false post under the spars E, and embrace the main post. Their use is to sustain the false post against a lateral shock.

G, Is a yoke made of an iron tiller, or other sufficient substitute, firmly fitted through the after part of the rudder near the surface of the water.

H H H, Are the temporary braces and pintles—They are formed of eye bolts drawn out of the gun carriages or from the various parts of the hull, masts, or caps, and driven into the false post and rudder alternately so that the eyes just meet each other; some of those in the post, below those in the rudder, and others above, in order to confine the rudder from rising—The pintles are made of crowbars, a kedge anchor-stock, or the long stout bolts out of the windlass bits.

h h h, Are the old rudder braces or the fragments thereof remaining on the post.

I, Is the profile of the stern of the ship.

K K, Are guys, the bites of which are well served and lashed to the after part of the false post, and lead separately (or combined as represented in the figure) to the fore and after parts of the main chains.

L L, Are knots worked on the guys to preserve them from chafing against the bottom and quarters.

M, Is a rope the bite of which is lashed to the after part of the rudder below the yoke, and also to the extremities of the yoke, and from thence led through blocks attached to the end of a spar projecting over each quarter to the wheel by which the ship is steered.

N, Is a slip rope rove through a hole in the heel of the rudder and both ends passed up through the rudder case to the head of the false post and made fast.

O, Is a grommet (travelling on the slip rope) to which a gun or kedge anchor or any sufficient weight is attached, in order to sink the rudder until it is hung and secured.

P, Is a hauling line attached to the grommet, and by which the weight is lowered down and hauled up. When the rudder is secured in its place, the weight is removed, and the slip rope unrove.

Q, are the rudder pendents to save the rudder in case of accident.

R, Is the lower deck.

S, Is the quarter deck.

T, Is the quarter rail.

V, The arch board of the Stern.

REMARKS.

The merit of this invention is to be tested by a just comparison with the best substitute hitherto known, which is undoubtedly that of Capt. Pakenham's excellent invention, an account and description of which may be found in the 7th volume of the Transactions of the London Society for the encouragement of arts, manufactures and commerce.

The difference consists in Captain Mugford's new and ingenious contrivance of a *false stern post*, to which his rudder is

secured by eye bolts serving as braces, and crow-bars or other substitutes as pintles, on which it works with as much ease and effect as the original rudder. The false post is also firmly secured to the main post by the guys, and the old rudder braces which are tenoned into it.

Captain Pakenham's rudder depends entirely upon the very slight hold which the cap has on the post, and does not appear to be sufficiently secured to resist a sudden lateral shock; it is however very simple in its construction, and requires, perhaps, less labor and fewer materials (particularly of iron) than Capt. Mugford's, and has the advantage of steering upon deck with a common tiller in the usual way.

Capt. Mugford's rudder must work with much less friction, and consequently will require less power, as the axis on which it moves is only an inch and a half in diameter, whereas that of Capt. Pakenham's is the diameter of the top-mast; say 10 or 12 inches.

Upon the whole, as the construction of Capt. Mugford's rudder requires only the skill and materials which are usually to be found on ship board, and as it appears to be better secured, and works with more ease than Capt. Pakenham's, it may (without derogating from the merit of the latter) be justly considered as a valuable and useful invention.

Capt. Mugford's rudder is susceptible of a very simple and important improvement, viz. If the archboard of the stern V was cut off, and the after part of the rudder case taken down, the stock of the rudder might be continued to the upper deck, and steer with the tiller in the usual way. Capt. Mugford's mode of steering is exceptionable, as the yoke is at the surface of the water, and the wheel ropes leading from the yoke to the spar, broad upon the quarter; the angle which the rope makes with the yoke when the rudder is hard over, is so obtuse as greatly to diminish the effort of the power; and moreover the rudder is necessarily so broad at the surface of the water, as to expose a dangerous resistance to the action of the sea.

It is also to be observed, that few merchant ships under 350 ton's burthen have either wheel or iron tiller. If the rudder was continued to the deck, the breadth might be diminished

at the surface of the water and enlarged at the heel, which would increase its effect and render it less liable to injury.

In the drawing, the cleats F F, are added to the side of the false post, and overlapping the main post, which will give it great additional security. Some minor alterations are also made, viz. In the drawing the four guys l l l l, (which are separate in the model) are combined into two K K, leading through a thimble or clinch; the reason is, that am ore equal tension can be obtained of two ropes than of four, and that when combined they lead in a fairer direction under the buttock of the ship.

Indeed the number of guys are superfluous, the lower one would be amply sufficient, as the upper end of the post can be made very secure. Captain Pakenham has but a *single* guy leading from the cap on each side.

The drawing represents a mode of applying and removing the weight to sink the rudder, by which the whole can be removed with more ease when the rudder is secured.

When the rudder is fixed, the only apprehension is, the guys chafing off. There is however on board every ship a complete remedy viz. Take two of the topmast back stay chain plates and one of the bolts, and bolt them to the heel of the false stern post, one on each side; to these hook the top-blocks and mouse the hooks well; then reeve the guys through the blocks, and take both parts to the fore part of the main chains: by this means the guys may be overhauled through the blocks and examined at pleasure, keeping them always well taught and veering away one part as you haul in upon the other. These remarks are the more diffuse as the subject is considered important, and is still susceptible of great improvement.

Captain Mugford was some days before he could hang his rudder, owing to bad weather.

The man will deserve well who shall invent a simple substitute for a rudder that can be made and applied immediately *in any weather;* and it need not be despaired of, if men of ingenuity, without waiting for the calamity, would only try experiments while their ships are in a sound state.